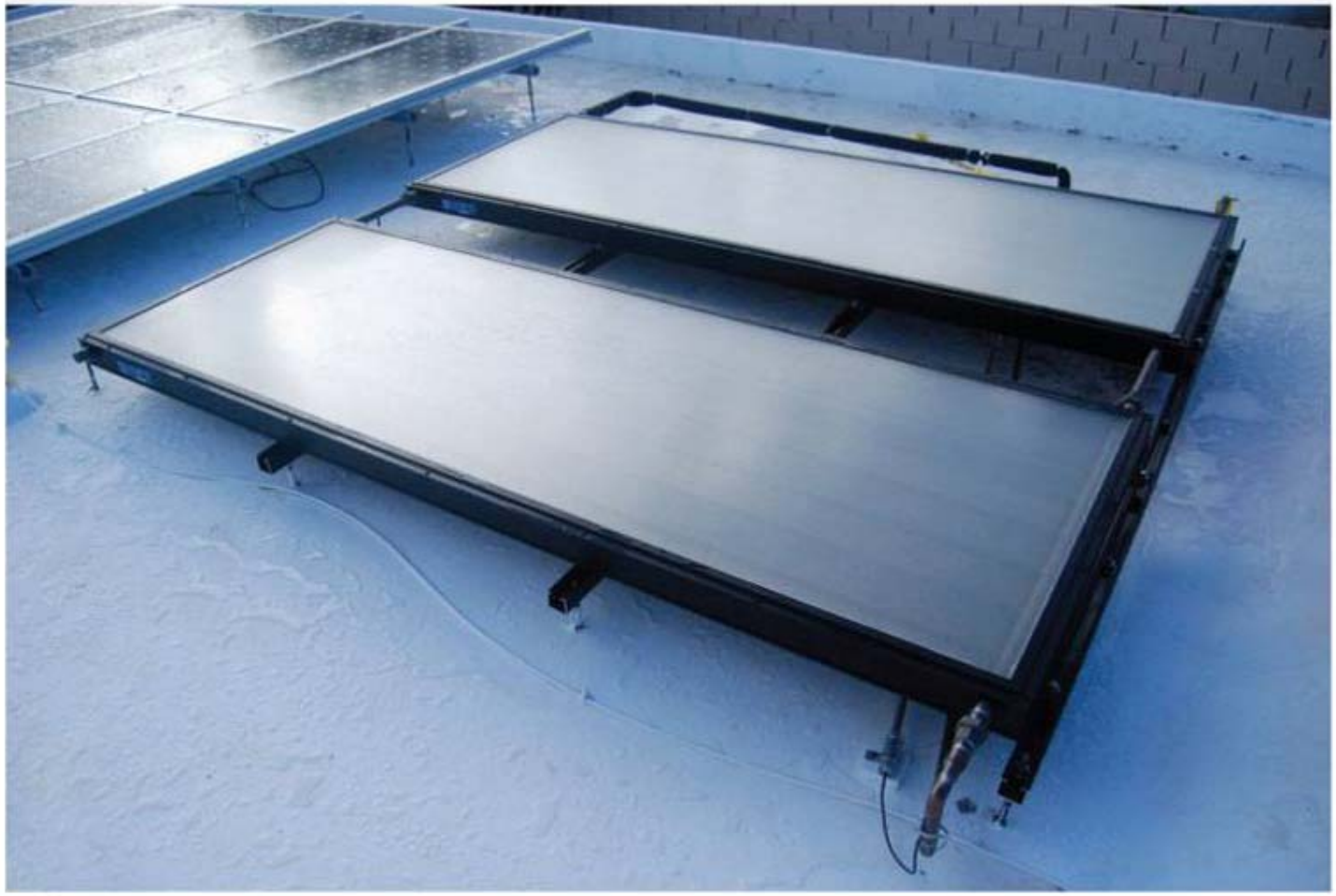
Pacific Solar & Photovoltaics



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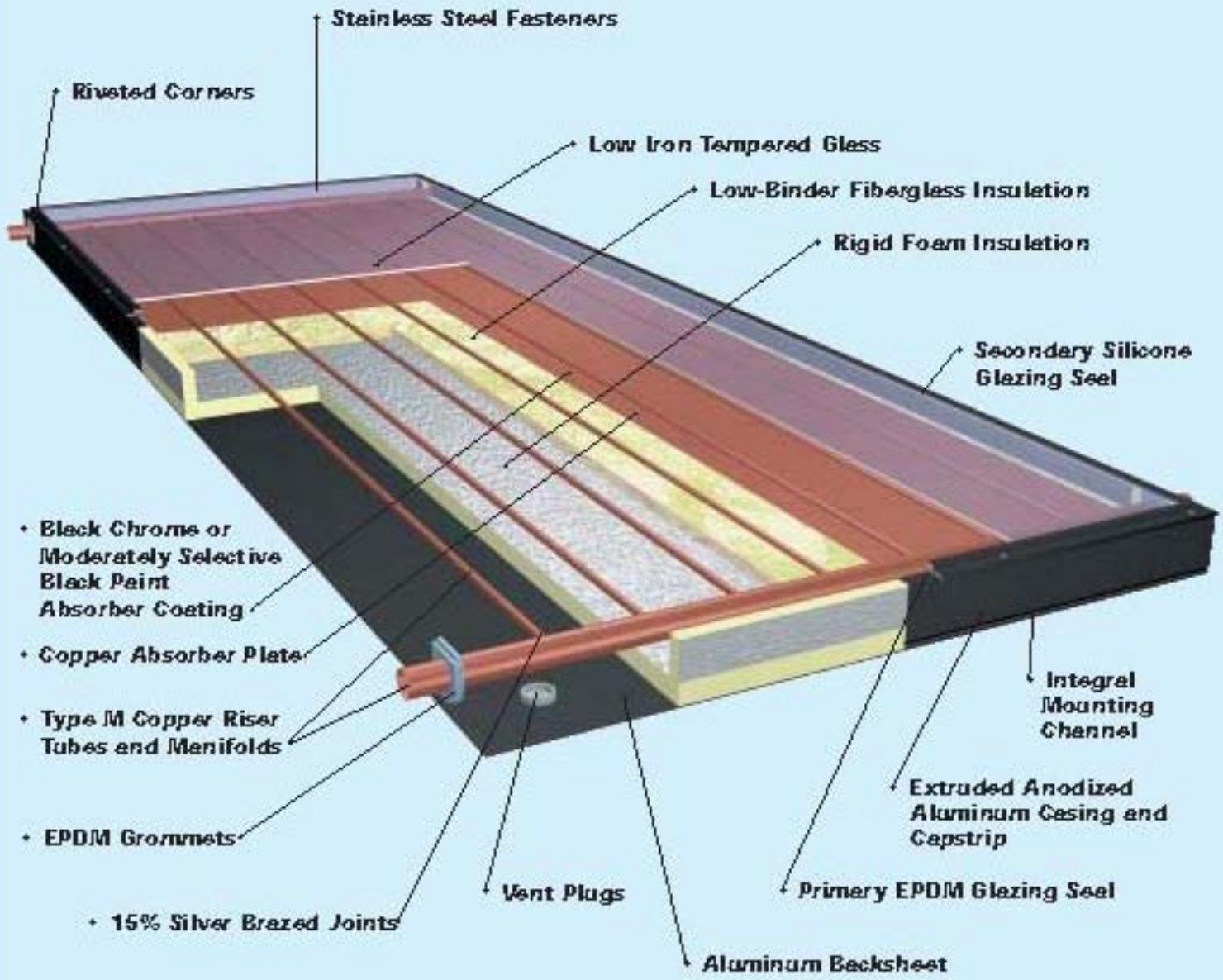
IN SOLAR WATER HEATING TECHNOLOGY



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E&A ENGINEERS

Project: Solar Panel - Mr. Hagen Residence

Comments: Solar Panel -

Job No. :
Designed by LNB
Sheet No.:
Date: Feb. 23, :

Subject: Design of Strut and Anchor

Reviewed by :
CPA

. Based on Technical specs: Sunmodule SW155/165/175 mono
Solar panel to be installed at Roof of Mr. Hagen's Two storey Residence

length =	63.39	inches
width =	31.89	inches
weight =	33.00	lbs
weight/sqft. =	2.35	psf

. Lateral Loads/Wind Load

Assume panel to hold the wind design velocity
Wind Velocity, V = 175 mph
two locations = Flat and slopping roof (96 hor: 14 vert)

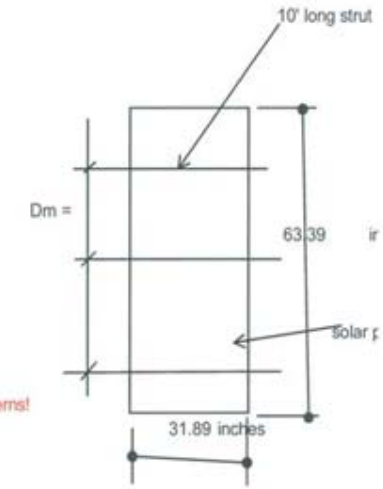
Per UBC Code :
WL = Ce Cq qs I

where :
Ce = 1.39 Exposure D at two storey height
Cq = 1.30 For unenclosed structures with slope < 58.3%

slopping roof (96 hor: 14 vert) slope = 14.50% < 58.3%
lopping roof (180 hor: 20 vert) slope = 6.34% < 58.3%

qs = 0.00256 V^2
78.65 psf
I = 1.0

.:
WL = (1.39) (1.30) (78.65) (1.0)
WL = 142.11 psf



Load Combination

Net Working Load = DL - WL = 2.35 - 142.11
-139.76 UPLIFT

let Ult Load 1= 0.9DL - 1.3WL = 0.9(2.35) - 1.3(142.11)
-182.63 UPLIFT governs!

let Ult Load 2= 1.2DL - 1.3WL = 1.2(2.35) - 1.3(142.11)
-181.92 UPLIFT

E&A ENGINEERS

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D. Design of Strut spacing holding Solar Panel -use working Load

Trial spacing= 24 inches; also called D_m

From technical specs of Solar Panel:

$F_L = D_m \times P_m$; lbs/ft should not exceed 300lb/ft in any application

where : P_m = -139.761 psf pressure the module is exposed, in psf
D_m = 24 inches; height of module being racked, in feet, strut spacing

$$F_L = \frac{(-139.761)\ (24)}{12}$$

F_L = -279.522 lbs/ft > 300 lbs/ft .: **ok**
use 24" on center strut spacing

However; **Technical Specs doesnot mentioned if Working Load or Ultimate load to use for design of Strut Spacing**
Code says, the most stringent Load should be used if specs is silent.

Trial spacing= 24 inches; also called D_m

therefore, use Ultimate load P_m = -182.629 psf pressure the module is exposed, in psf
D_m = 24 inches; height of module being racked, in feet, strut spacing

$$F_L = \frac{(-182.629)\ (24)}{12}$$

F_L = -365.259 lbs/ft > 300 lbs/ft .: **not ok**

DCR : 1.218 **21.8%** **overstressed, and more than 10% therefore not acceptable.**

Trial spacing= 20 inches; also called D_m

therefore, use Ultimate load P_m = -182.629 psf pressure the module is exposed, in psf
D_m = 20 inches; height of module being racked, in feet,strut spacing

$$F_L = \frac{(-182.629)\ (20)}{12}$$

not ok but acceptable
F_L = -304.382 lbs/ft > 300 lbs/ft .: **use 20" on center strut spacing**

DCR : 1.015 **1.5%** **overstressed, but less than 10% therefore tolerable.**

E. Design of Anchor Bolt for Strut Holding Solar Panel **using 20" spacing - use Ultimate Load**

From technical specs of Solar Panel:

P_m = -182.629 psf **Governing Net Ultimate pressure** the module is exposed, in psf
use D_m = 20 inch designed strut spacing using ultimate load

$F_f = F_L \times D_f$; psf

where : F_L = -3652.6 lbs/ft Linear Load, not exceeding 300lbs/ft
D_f = 10 ft strut free spun, length of strut

F_f = 3652.6 x 10'
F_f = -36525.9 lbs

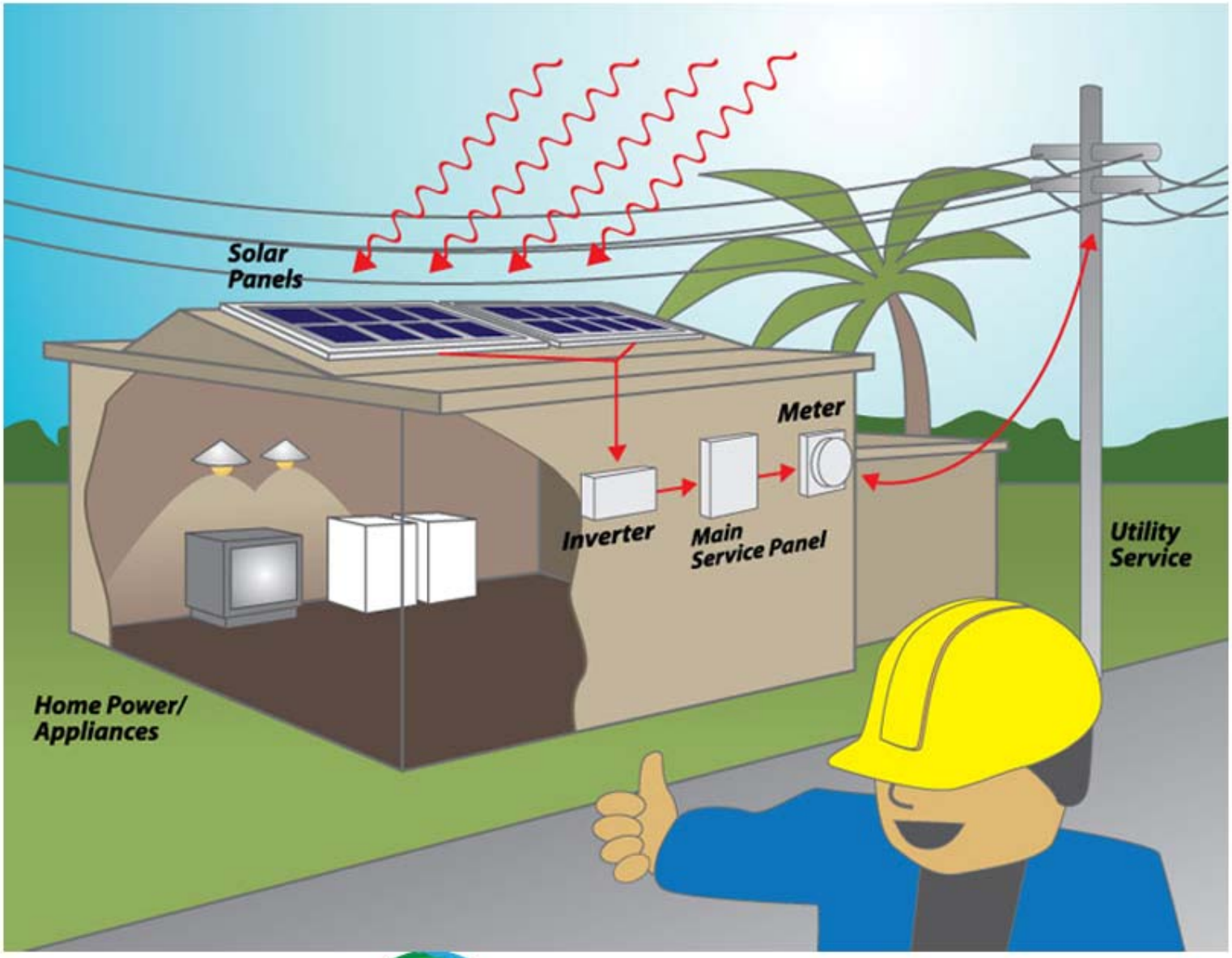
Try 22 inches SSTL Anchor Bolt spacing
n = 10 x 12/20"
n = 5.450 pcs. use n = 6

Check Tension
Governing Ultimate Uplift Force per Bolt

$$\text{Uplift Force per Bolt} = \frac{-182.63}{12} \times \frac{20.00}{6} \times \frac{10.00}{} = -507.30 \text{ lbs}$$

Technical specs load factor x 2.0
-1014.6 lbs
Factor without inspection x 1.5
-1521.9 lbs **> 3630 lbs**

.: **use 3/8" SSTL Bolt @ 22" spacing with 3-3/8" embedment with 20 inches strut spacing**



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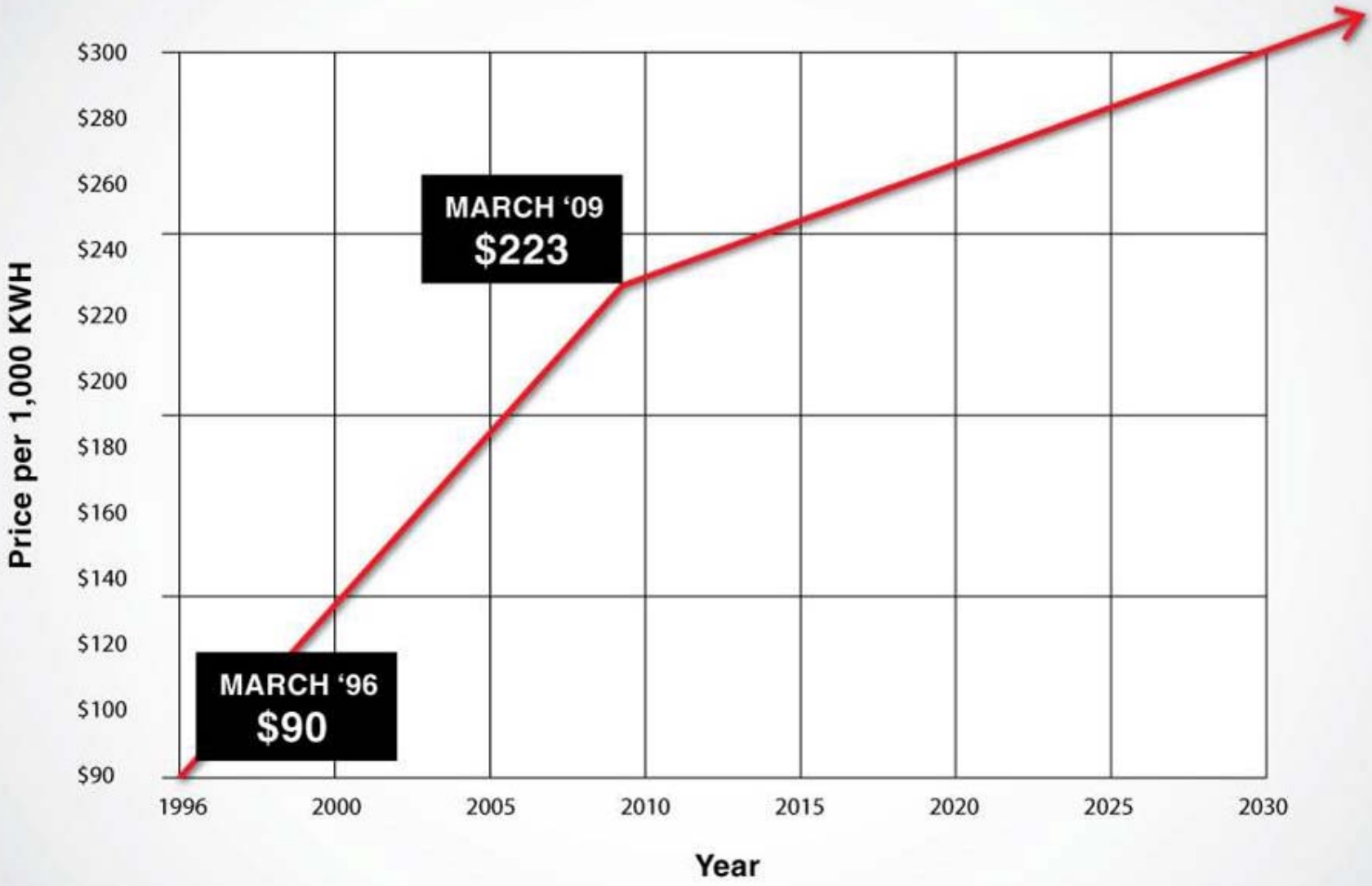
GPA Rate Increase



Source: Guam Power Authority

TURN YOUR METER BACKWARDS

Pacific Solar & Photovoltaics

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